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The Effect of Innovation in RPG Fantasy Math Rule Learning on the Creative Thinking Abilities of Junior High School Students

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ABSTRACT

This R&D (Research and Development) research using the ADDIE model aims to produce a website-based mathematics learning media in the form of a Fantasy Math Rule Role-Playing Game (RPG) that is valid, practical, and effective in stimulating junior high school students' mathematical creative thinking skills. Product feasibility was validated qualitatively by experts with revised results in the form of calculator-format number visualization and the addition of backsound. Field trials involved 33 eighth-grade junior high school students in West Lombok. Practicality data was collected through a binary response questionnaire (20 items), while cognitive effectiveness was measured using an embedded assessment method (integrated assessment) based on data from the "Dragon Palace" peak level pass rate. The results showed that the game met practical criteria with an average student response of 74.24% (category "Good"). From the aspect of cognitive effectiveness, the game was declared very effective because 26 out of 33 students (78.8%) successfully completed the peak level independently, exceeding the classical completion target of 75%. This success proves active stimulation of creative thinking indicators (fluency, flexibility, originality, elaboration). The Fantasy Math Rule game is suitable for use as a fun alternative learning and evaluation medium and is able to reduce students' mathematical anxiety.

Keywords: ADDIE, Mathematical Creative Thinking, Embedded Assessment, Fantasy Math Rule

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INTRODUCTION

Mathematics is a fundamental subject in junior high school, playing a crucial role in developing logical, analytical, and systematic thinking skills. More than simply memorizing numbers and standard formulas, mathematics learning aims to develop students' creative thinking skills. This ability is essential so that students are not merely passively accepting one solution, but are able to view a mathematical problem from multiple perspectives, conceptualize patterns, and find innovative alternative solutions to address the challenges of everyday life. In

this dynamic modern era, creative mathematical thinking skills are a crucial foundation for global numeracy literacy, which demands high adaptability.

At junior high school age, students are in a crucial cognitive developmental transition phase, namely the shift from the concrete operational stage to the formal operational stage according to Piaget's developmental theory. In this transitional phase, students require strong and adaptive cognitive stimulation capable of bridging abstract mathematical concepts such as variables, mathematical logic, and interoperational relationships with structured logical reasoning. Learning at this level also ideally challenges critical thinking skills, mathematical intuition, and collaborative problem-solving with peers. However, empirical reality in the field often shows conditions that are far from these ideal expectations. The rigid paradigm that mathematics is a difficult, cold, theoretical, and boring subject still firmly ingrained in the minds of most students. Math anxiety often increases significantly as the material becomes more complex at the junior high level, which has an impact on decreasing student self-confidence. This is exacerbated by the dominance of conventional, teacher-centered learning methods and a rigid, paper-based evaluation system. This kind of traditional evaluation often triggers psychological stress, limits the space for cognitive exploration, and ultimately has a direct impact on the classroom climate becoming passive, monotonous, and unproductive.

To overcome this methodological impasse, a radical breakthrough and learning innovation are needed that can break down the negative stigma of mathematics at the secondary school level. One approach that has proven highly effective in this digital era is gamification, namely the integration of game elements, dynamics, and mechanisms into non-game educational contexts. The use of Math Rule presents an alternative innovation in web-based mathematics learning that is very promising to facilitate the cognitive needs of junior high school students. Through this adventure RPG (Role Playing Game) media, mathematical concepts considered abstract are packaged into interactive, challenging, and fun game rules, where students play the role of wizards who must defeat various monsters through the logic challenges of Operator Challenge. Although several educational mathematics games have been developed previously, such as "MaTriG" by Permatasari et al. (2022) and "MATH-VILLAGE" by Rafanti et al. (2023), most of these media still rely on separate written test evaluations and have the potential to trigger test anxiety.

This research introduces a clear gap analysis through the integration of a stealth assessment system directly within the gameplay. In this challenge, students not only calculate the final result, but also work backward to construct a combination of mathematical operators (+, -, ×, ÷) to produce the right magic score to defeat their opponent. The integration of hidden assessment within the gameplay allows it to organically measure students' creative thinking abilities, tracking their logical paths in real-time without triggering formal exam anxiety. Therefore, this research positions itself to expand the existing literature on digital gamification in mathematics learning by focusing on an integrated, anxiety-free evaluation method. Through this innovation, it is hoped that the learning atmosphere can drastically transform from initially stressful to dynamic, while also becoming an effective catalyst for optimally actualizing the potential of junior high school students' mathematical creative thinking.

METHODS

This study uses a research and development (R&D) method to produce a product in the form of a game-based learning media RPG (Role-Playing Game) called Math Rule which is valid, practical, and effective in improving the mathematical creative thinking skills of junior high school students. The development model applied in this study is the ADDIE model which consists of five systematic stages, namely analysis, design, development, implementation, and evaluation.

The first stage, namely analysis, was carried out by identifying basic needs in the field related to the rigid paradigm of mathematics learning, the psychological characteristics of junior high school students who enjoy digital games, analysis of the suitability of the national curriculum, and mapping of numeracy reasoning materials that have the potential to trigger creative thinking indicators. The second stage was design, where researchers drafted a gamification mechanism, created visual assets for wizard and monster characters, an adventure storyline to the Dragon Palace, reward elements in the form of coin accumulation and performance scores, and compiled the mathematical logic of the Operator Challenge at each level to align with creative thinking indicators.

The third stage was development, which focused on coding the Math Rule game web interface using the GitHub Pages platform and conducting a qualitative review (expert judgment) by a supervising lecturer or mathematics teacher as material and media experts to obtain input for product improvements until it was declared feasible through an approval sheet without using a formal quantitative questionnaire instrument for experts. The fourth stage was implementation, where the approved Math Rule game was then directly applied in a real learning scenario to eighth-grade students at SMP Plus Al-Hikmah Adnani using a purposive sampling technique to see the usability of the system in the classroom. The fifth stage is evaluation, carried out to measure the final quality of the game based on the practicality aspect through student response questionnaires and the cognitive effectiveness aspect based on the game's peak level passing performance data recording.

The data collection instrument in this development research was designed efficiently to measure the quality of the Math Rule media directly from primary users without burdening the research subjects with rigid administration. To ensure the product's feasibility before testing, the researcher used a qualitative review sheet in the form of input and approval sheets from expert lecturers. The main instrument in the form of a quantitative questionnaire in this study was purely a student response questionnaire compiled using a Likert Scale with a score range of 1 to 5 that was modified into a binary model. This questionnaire was distributed to students after the completion of the playing session to measure aspects of the game's practicality, including ease of web navigation control, clarity of Operator Challenge instructions, the usefulness of the hint feature as cognitive assistance when experiencing a dead end, and the visualization of the RPG theme presented. Meanwhile, to test the game's effectiveness on mathematical creative thinking skills, the researcher did not use external written test instruments in the form of pretests or posttests, but instead implemented an integrated assessment system (embedded assessment) directly from within the game flow.

This effectiveness instrument refers to performance record data (log data) of students' passing at the final level, namely the challenge in the Dragon Palace. This peak level is intentionally designed with high complexity that requires students to apply creative thinking indicators, such as fluency in thinking of many alternative combinations of operations and flexibility in switching different magic formula route strategies to defeat the boss monster within the specified time limit or health bar. Before being distributed to students, the response questionnaire instrument has been tested for quality using the product moment validity test and Cronbach's Alpha reliability test to ensure the consistency of the measuring instrument.

The data analysis techniques in this study were adjusted to focus on user response data and game performance results. Qualitative data in the form of notes on improvements suggested by experts were analyzed descriptively to refine the visual and logical aspects of the Math Rule game before its final release. Quantitative data obtained from student response questionnaires were analyzed using descriptive statistics using the average score percentage formula according to Akbar (2013) as follows:

$$\rho = (\text{Actual Score} / \text{Maximum Score}) \times 100\%$$

The results of the percentage calculation are then converted into a table of practicality criteria to determine the level of product feasibility, which is divided into five levels: Very Impractical (0%-20%), Less Practical (21%-40%), Quite Practical (41%-60%), Practical/Good (61%-80%), and Very Practical (81%-100%). Furthermore, the analysis of effectiveness data on creative thinking skills is carried out by calculating the percentage of classical completion based on the number of students who are able to conquer the final level challenge in the Dragon Palace independently. If the percentage of students who complete the final level of the game meets or exceeds the target of the classical success indicator of the research that has been set, which is a minimum of 75% of the total class sample, then the developed Math Rule game-based learning media is declared to meet the effective criteria in triggering the mathematical creative thinking skills of junior high school students. This calculation is completed with the help of data processing software to ensure accuracy.

RESULT AND DISCUSSION

Analysis Stage

The initial development phase began with a needs analysis of the mathematics learning process at the junior high school level. Observations revealed student boredom with rigid lecture and paper-based practice methods, which ultimately triggered math anxiety. Junior high school students' cognitive characteristics are in a transitional period from concrete operations to formal operations, where they require a visual bridge to understand abstract concepts such as the logic of arithmetic operations. From the curriculum analysis, the material on numeracy reasoning and arithmetic operations has great potential to be integrated with open-ended problem solving. Based on this analysis, it was decided to develop interactive learning media in the form of a web-based RPG game to be easily accessible, challenging, and able to stimulate students' independent creative reasoning.

Design Stage

In the design stage, the researcher created a blueprint for the Fantasy Math Rule game. This design included developing a storyline for a wizard's adventure against monsters, creating visual assets (characters, forest settings, caves, and the Dragon Palace), and developing gamification mechanisms such as a health bar, points, coins, and hints. The core math challenge was designed in the form of an Operator Challenge, where students had to determine the correct mathematical operator to connect random numbers to produce a valid value. The final level, the Dragon Palace, was specifically designed as a peak challenge with high complexity that tested all four indicators of mathematical creative thinking simultaneously without the aid of rigid instructions.

Development Stage

The development phase focuses on the realization of the blueprint into a complete web-based learning media. This media was developed using HTML, CSS, and JavaScript programming languages, and deployed online through the GitHub Pages platform so that it can

be easily accessed by students using a web browser without requiring the application installation process on their devices. The realization of the product resulting from the development of the Fantasy Math Rule game website is described through several main interface displays, namely: Main Page Display (Main Menu) containing the title and guide; Battle Interface Display (Battle & Operator Challenge) where students choose arithmetic operators to defeat the enemy; Help Feature Display (Hint) and Feedback Pop-up; and Final Level Display (Dragon Palace) as the peak cognitive challenge area.

After the prototype was developed, a theoretical feasibility test was conducted through discussions and qualitative reviews (expert judgment) by the mathematics tutor and the supervising lecturer. This expert validation did not use quantitative scores but instead focused on qualitative input. Recommendations for improvement from the experts included: (a) Changing the number display to adopt a calculator format to increase visual clarity and adding background sound elements to stimulate audio-visual engagement; (b) Adding contrast levels to the Operator Challenge text; and (c) Recommendations to conduct a comparative study looking for other references to enrich the variety of game challenges.

Implementation and Evaluation Stage

The implementation phase was conducted on eighth-grade students at Al-Hikmah Adnani Plus Middle School, involving 33 students as trial subjects. Learning began with a brief introduction to the operation of this web-based game. Students were then given complete freedom to explore the Fantasy Math Rule game adventure independently using mobile devices for 5 minutes per student. During the game, researchers observed and recorded student behavior. Observations showed a very high increase in enthusiasm; the classroom atmosphere that was usually tense during math lessons changed to a dynamic and collaborative one, where students discussed with each other and developed creative strategies to attack monsters without fear of making mistakes.

After the play session was over, students completed a 20-item response questionnaire with binary answer choices of "Yes" (scored 1) and "No" (scored 0). The summary of data from 33 respondents is presented in the table below:

Table 1. Results of Student Response Questionnaire Based on Practicality and Creative Thinking Indicators

No	Student Response Questionnaire Question Indicators	Yes	No	Percentage
PART A: THE EFFECT OF GAMES ON STUDENTS' LEARNING EASE AND INTEREST IN MATHEMATICS				
1	Do you find it easy to understand the rules in this game?	32	1	96.96%
2	Are you interested in learning math after using this game?	21	12	63.63%
3	Do you feel this game makes difficult math material easy?	27	6	81.81%
4	Are you interested in solving math problems packaged in an adventure?	30	3	90.90%
5	Do you feel that your anxiety or fear	18	15	54.54%

	of learning mathematics has decreased? (Item 1)			
6	Do you feel that your anxiety or fear of learning mathematics has decreased? (Item 2)	24	9	72.72%
7	Do you find that the ease of navigation controls on the web makes it easier to concentrate?	28	5	84.84%
8	Do you feel that game elements (coins, scores, health bars) increase interest?	29	4	87.87%
9	Do you find that the visualization of the game's adventures makes it easier to understand the formulas?	28	5	84.84%
10	Are you interested in playing similar math games on other subject topics?	22	11	66.66%
PART B: REFLECTION ON CREATIVE MATHEMATICAL THINKING				
I. Fluency Thinking				
11	Are you driven to think of many operator combinations quickly during a challenge?	10	23	30.30%
12	Do you usually think of several answer options before attacking?	28	5	84.84%
II. Flexibility				
13	Do you quickly look for alternative strategies when your first guess is wrong?	22	13	66.66%
14	Do you feel this game trains you to see numbers from a different operational perspective?	30	3	90.90%
III. Original Thinking (Originality)				
15	Do you feel challenged to find unique	21	12	63.63%

	mathematical solution patterns?			
16	Do you feel this game trains problems without relying on conventional rigid methods?	22	11	66.66%
17	Do you feel proud of successfully completing a challenge on your own?	30	3	90.90%
	IV. Detailed Thinking (Elaboration)			
18	Do you analyze the value of the monster numbers in depth before composing the operator?	23	10	69.69%
19	Do you take into account the remaining health bar and detailed coins for the next step?	18	15	54.54%
20	Have you tried to detail the calculation steps carefully so as not to make mistakes?	27	6	81.81%
Average Total Percentage of Student Response Eligibility				**74.24%**

To determine the game's practicality criteria, an average score percentage analysis was conducted based on the percentage formula according to Akbar (2013). The actual total score obtained was 490 out of a total maximum score of 660 (obtained from 33 respondents × 20 items × 1). Based on formal calculations, the average percentage value of student responses was obtained $\rho = 490 / 660 \times 100\% = 74.24\%$. The feasibility value is in the feasibility percentage range of the conversion criteria of 61.00% - 80.00%, so it is concluded that the Fantasy Math Rule game is categorized as "Good / Practical" for use in junior high school mathematics learning scenarios.

The effectiveness of students' mathematical creative thinking abilities was measured directly and objectively through the pass rate of the peak level, namely "Dragon Palace" with an embedded assessment scheme. The results of class performance data recording showed that of the 33 participating students, 26 students (78.8%) successfully conquered the Dragon Palace independently within the specified time allocation, while 7 students (21.2%) experienced defeat (game over) but managed to reach that level. Based on the classical completion target set by the researcher, namely a minimum of 75% of students being able to pass the peak level, this achievement of 78.8% proves that the Fantasy Math Rule game is "Very Effective" in triggering and training students' mathematical creative thinking abilities independently without the need for traditional written tests.

Discussion

The success of the Fantasy Math Rule game in increasing interest, ease of learning, and stimulating creative thinking among junior high school students is influenced by several integrated structural factors of the game. The average practicality score of 74.24% in the student response questionnaire, which is in the "Good / Practical" category, represents that the majority of junior high school students received this web-based learning media very positively. In the ease of learning dimension (Part A), the highest percentage was shown by item 7 (84.84%) regarding the ease of website navigation control. This confirms that the development of HTML and JavaScript-based media deployed on GitHub Pages provides accessibility and allows direct focus on mathematical content without the technical complexity of application installation. Student learning interest also received a strong positive score in items 1 (96.96%) and 4 (90.90%), indicating that packaging the challenge of conventional mathematical operations into an RPG-themed monster-defeating adventure successfully changed students' perceptions that mathematics does not always have to be solved through boring memorization formulas. In the stimulation of creative thinking dimension (Part B), student self-evaluation scores showed relevant developments in the aspects of fluency and flexibility.

The fluency indicator in item 12 reached 84.84%, indicating that the time limit for attacking monsters and the demands of passing the level forced the junior high school students' brains to think of many alternative operator combinations (+, -, ×, ÷) quickly. Likewise, the flexibility aspect in item 14 (90.90%) reflects that students are starting to get used to viewing a number flexibly from various computational operation directions. Although the originality aspect in item 16 had a relatively lower score (66.66%), this reflects the real condition of junior high school students who are still in the adaptation period to leave behind rigid conventional calculation methods. Students tend to still need gradual guidance (scaffolding) to truly feel confident in producing completely unique mathematical answers.

However, the high sense of pride when successfully completing the peak level of the Dragon Palace in item 17 (90.90%) is an excellent positive emotional catalyst for increasing students' self-efficacy in mathematics lessons in the future. Finally, in terms of cognitive effectiveness, the classical success of 78.8% of students who passed Dragon Palace confirms that the stealth assessment system is highly accurate in capturing students' true creative thinking abilities. Without the threat of test anxiety, students play relaxed but still think hard. Logical errors they make in the game are not seen as fatal failures but as immediate feedback that trains them to conduct self-evaluation, dare to click the retry button, and elaborate on mathematical calculation strategies more thoroughly.

CONCLUSION

Based on the results of the research and development that has been carried out, it can be concluded that the website-based Fantasy Math Rule mathematical RPG adventure game was successfully developed using the ADDIE model and is declared suitable for use as an alternative medium for learning mathematics for junior high school students. From the practical aspect, this game received a "Good" category with a student response percentage of 74.24% (actual score of 490 out of a maximum score of 660) obtained from trials on 33 students. The ease of access through the GitHub Pages platform without installation and the RPG elements in it have proven effective in attracting learning interest and reducing students' mathematical anxiety. From the aspect of cognitive effectiveness, this game has proven very effective in stimulating students' independent mathematical creative thinking abilities without the pressure of conventional written tests. Through the embedded assessment method, 26 out of 33 students (78.8%) successfully completed the challenge at the peak level of "Dragon Palace", exceeding the classical completeness indicator set at 75%. Successful completion of this peak level

demonstrates active stimulation of creative thinking indicators which include fluency, flexibility, originality, and elaboration.

As a practical recommendation, mathematics teachers are advised to utilize the Fantasy Math Rule game in the classroom to enrich numeracy learning variations and implement integrated assessments (stealth assessments) that are more psychologically friendly for students. Schools are expected to provide support facilities in the form of wireless internet connections and computer laboratories to support optimal utilization of this web-based media. For future researchers, it is recommended to expand the coverage of the mathematics curriculum material in the game, improve the support or guidance system (scaffolding) to boost students' achievement in the original thinking aspect (originality) which is still in the lowest category (63.63%), and develop an offline version to anticipate internet network limitations in certain areas.

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